

WHAT IS CLAIMED IS:

1 1. A process for forming a patterned thin film structure on a
2 substrate, comprising:
3 printing a pattern on the substrate using a strippable material comprising
4 5-80% by weight of a re-dispersible particulate, the printed strippable
5 material defining an area on the substrate where the thin film structure is
6 to be formed by comprising a negative image thereof such that the
7 printed strippable material is present in areas on the substrate where the
8 thin film structure is not to be formed and the printed strippable material
9 is substantially not present in the area on the substrate where the thin
10 film structure is to be formed;
11 depositing a thin film of material on the patterned substrate; and
12 stripping the strippable material from the substrate;
13 whereby the strippable material and any thin film material formed thereon
14 are removed by said stripping leaving behind the thin film structure.

1 2. The process for forming a patterned thin film structure on a
2 substrate as recited in claim 1, wherein the strippable material comprises 10-
3 60% by weight of the redispersible particulate.

1 3. The process for forming a patterned thin film structure on a
2 substrate as recited in claim 1, wherein the strippable material comprises a
3 water soluble or water dispersible polymer as a binder.

1 4. The process for forming a patterned thin film structure on a substrate as
2 recited in claim 3, wherein said water soluble polymer is selected from the group
3 consisting of polyvinyl alcohol, polyvinylpyrrolidone, polyvinylpyridine,
4 polyacrylic acid, polymethacrylic acid, polyacrylamide, polyethyleneglycol,
5 poly(ethylene-co-maleic anhydride), poly (vinylether-co-maleic anhydride),
6 poly(styrene-co-maleic anhydride), poly(butylene-co-itaconic acid), PEOX,
7 polystyrene sulfonate, cellulose derivatives such as hydroxyethyl cellulose,
8 hydroxypropyl cellulose, methyl cellulose, carboxymethyl cellulose, xanthan
9 gum, gum Arabic, gelatin, lecitin, and their copolymers.

1 5. The process for forming a patterned thin film structure on a
2 substrate as recited in claim 3, wherein the binder comprises a water dispersible
3 polymer selected from water dispersible wax, alkaline dispersible wax,
4 polyolefin, or acrylic latexes or dispersions.

1 6. The process for forming a patterned thin film structure on a
2 substrate as recited in claim 1, wherein the strippable material comprises a
3 solvent soluble or solvent dispersible polymer as a binder.

1 7. The process for forming a patterned thin film structure on a
2 substrate as recited in claim 1, wherein the particulate is derived from silica,
3 CaCO₃, CaSO₄, BaSO₄, Al₂O₃, TiO₂, hollow-spheres, non-film-forming latexes
4 or dispersions, inorganic pigment, or organic pigment.

1 8. The process for forming a patterned thin film structure on a
2 substrate as recited in claim 1, wherein the particulate is a polymeric particle or
3 a polymeric composite particle.

1 9. The process for forming a patterned thin film structure on a
2 substrate as recited in claim 1, wherein the strippable material comprises an
3 additive selected from the group consisting of surfactants, dyes, curing agents,
4 and plasticizers; whereby the presence of said additive facilitates the stripping of
5 the strippable material subsequent to the deposition of the thin film.

1 10. The process for forming a patterned thin film structure on a
2 substrate as recited in claim 1, wherein the step of stripping comprises using a
3 solvent to remove the strippable material.

1 11. The process for forming a patterned thin film structure on a
2 substrate as recited in claim 10, wherein the solvent is selected from the group
3 consisting of water, aqueous solutions, alcohols, ketones, esters, ethers,
4 amides, hydrocarbons, alkylbenzenes, pyrrolidones, sulfones, DMSO, and their
5 mixtures and derivatives.

1 12. The process for forming a patterned thin film structure on a
2 substrate as recited in claim 1, wherein the thin film material is non-conductive.

1 13. The process for forming a patterned thin film structure on a
2 substrate as recited in claim 1, wherein the thin film material is semi-conductive.

1 14. The process for forming a patterned thin film structure on a
2 substrate as recited in claim 1, wherein the thin film material is conductive.

1 15. The process for forming a patterned thin film structure on a
2 substrate as recited in claim 14, wherein the conductive thin film material is a
3 material selected from the group consisting of metals, metal oxides, and their
4 alloys and multilayer composites.

1 16. The process for forming a patterned thin film structure on a
2 substrate as recited in claim 14, wherein the conductive material is a metal
3 selected from the group consisting of aluminum, copper, zinc, tin, molybdenum,
4 nickel, chromium, silver, gold, iron, indium, thallium, titanium, tantalum,
5 tungsten, rhodium, palladium, platinum and cobalt.

1 17. The process for forming a patterned thin film structure on a
2 substrate as recited in claim 14, wherein the conductive material is a metal
3 oxide selected from the group consisting of indium tin oxide (ITO), indium zinc
4 oxide (IZO), aluminum zinc oxide, gadolinium indium oxide, tin oxide, or fluorine-
5 doped indium oxide.

1 18. The process for forming a patterned thin film structure on a
2 substrate as recited in claim 1, wherein the step of depositing a thin film
3 comprises sputtering.

1 19. The process for forming a patterned thin film structure on a
2 substrate as recited in claim 1, wherein the step of depositing a thin film
3 comprises vapor deposition.

1 20. The process for forming a patterned thin film structure on a
2 substrate as recited in claim 1, wherein the step of depositing a thin film
3 comprises vacuum deposition.

1 21. The process for forming a patterned thin film structure on a
2 substrate as recited in claim 1, wherein the step of depositing a thin film
3 comprises electroplating.

1 22. The process for forming a patterned thin film structure on a
2 substrate as recited in claim 1, wherein the step of depositing a thin film
3 comprises electro-less plating.

1 23. The process for forming a patterned thin film structure on a
2 substrate as recited in claim 1, wherein the step of depositing a thin film
3 comprises electroforming.

1 24. The process for forming a patterned thin film structure on a
2 substrate as recited in claim 1, wherein the step of printing comprises
3 flexographic printing.

1 25. The process for forming a patterned thin film structure on a
2 substrate as recited in claim 1, wherein the step of printing comprises
3 driographic printing.

1 26. The process for forming a patterned thin film structure on a
2 substrate as recited in claim 1, wherein the step of printing comprises
3 electrophotographic printing.

1 27. The process for forming a patterned thin film structure on a
2 substrate as recited in claim 1, wherein the step of printing comprises
3 lithographic printing.

1 28. The process for forming a patterned thin film structure on a
2 substrate as recited in claim 1, wherein the step of printing comprises gravure
3 printing.

1 29. The process for forming a patterned thin film structure on a
2 substrate as recited in claim 1, wherein the step of printing comprises thermal
3 printing.

1 30. The process for forming a patterned thin film structure on a
2 substrate as recited in claim 1, wherein the step of printing comprises inkjet
3 printing.

1 31. The process for forming a patterned thin film structure on a
2 substrate as recited in claim 1, wherein the step of printing comprises screen
3 printing.

1 32. The process for forming a patterned thin film structure on a
2 substrate as recited in claim 1, wherein the substrate comprises a plastic
3 substrate.

1 33. The process for forming a patterned thin film structure on a
2 substrate as recited in claim 32, wherein the patterned thin film structure
3 comprises a flexible printed circuit board or a portion of a flexible printed circuit
4 board.

1 34. The process for forming a patterned thin film structure on a
2 substrate as recited in claim 32, wherein the plastic substrate comprises a
3 portion of a roll of plastic substrate.

1 35. The process for forming a patterned thin film structure on a
2 substrate as recited in claim 34, wherein the process for forming a patterned
3 thin film structure on a substrate is a component part of a roll-to-roll process for
4 fabricating a display.

1 36. The process for forming a patterned thin film structure on a
2 substrate as recited in claim 35, wherein the display is an electrophoretic
3 display.

1 37. The process for forming a patterned thin film structure on a
2 substrate as recited in claim 35, wherein the display is a passive matrix
3 electrophoretic display.

1 38. The process for forming a patterned thin film structure on a
2 substrate as recited in claim 35, wherein the display is an in-plane switching
3 electrophoretic display.

1 39. The process for forming a patterned thin film structure on a
2 substrate as recited in claim 35, wherein the display is a dual-mode switching
3 electrophoretic display comprising a plurality of electrophoretic cells filled with
4 charged particles and a colored solvent in which the display is configured such
5 that the particles can be driven between the top and bottom of the
6 electrophoretic cells in a first mode and can be driven horizontally (in-plane) in a
7 second mode.

1 40. The process for forming a patterned thin film structure on a
2 substrate as recited in claim 1, further comprising laminating the substrate with
3 the thin film structure formed thereon to a display medium layer.

1 41. The process for forming a patterned thin film structure on a
2 substrate as recited in claim 40, wherein the display medium layer comprises a
3 layer of electrophoretic cells.

1 42. The process for forming a patterned thin film structure on a
2 substrate as recited in claim 41, wherein said electrophoretic cells are prepared
3 by embossing.

1 43. The process for forming a patterned thin film structure on a
2 substrate as recited in claim 41, wherein said electrophoretic cells are closed
3 and sealed by a polymeric sealing layer.

1 44. The process for forming a patterned thin film structure on a
2 substrate as recited in claim 1, wherein the thin film structure comprises an
3 electrode.

1 45. The process for forming a patterned thin film structure on a
2 substrate as recited in claim 44, wherein the electrode is a segment electrode.

1 46. The process for forming a patterned thin film structure on a
2 substrate as recited in claim 44, wherein the electrode is a column electrode.

1 47. The process for forming a patterned thin film structure on a
2 substrate as recited in claim 44, wherein the electrode is a row electrode.

1 48. The process for forming a patterned thin film structure on a
2 substrate as recited in claim 44, wherein the electrode is a pixel electrode.

1 49. The process for forming a patterned thin film structure on a
2 substrate as recited in claim 1, wherein the thin film structure comprises a
3 conductive trace.

1 50. A process for forming a patterned thin film structure on a
2 substrate, comprising:
3 printing on the substrate with a printable first material a pattern that
4 defines the area where the thin film structure is to be formed by
5 comprising a positive image thereof such that the printable first material
6 is printed in the area where the thin film structure is to be formed, the
7 printable first material being strippable using a first solvent;
8 overcoating the printed surface of the substrate with a second material
9 that is not strippable using the first solvent;
10 stripping the first material away using the first solvent in a process that
11 strips away the first material and any portions of the second material
12 formed on the first material without stripping away the portions of the
13 second material formed directly on the substrate, such that the second
14 material remains coated on the portions of the substrate where the first
15 material was not present, thereby defining the boundaries of the thin film
16 structure by comprising a negative image thereof such that the second
17 material is not present in and the first material has been stripped from the
18 area where the thin film structure is to be formed;

19 depositing a thin film layer on the patterned top surface of the substrate;
20 and
21 stripping the second material to form the thin film structure.

1 51. The process for forming a patterned thin film structure on a
2 substrate as recited in claim 50, wherein the first material repels the second
3 material such that the second material fills in the areas of the substrate between
4 the areas where the first material has been printed without coating the areas
5 where the first material is present.

1 52. The process for forming a patterned thin film structure on a
2 substrate as recited in claim 50, wherein the first solvent is an aqueous solution
3 or water.

1 53. The process for forming a patterned thin film structure on a
2 substrate as recited in claim 50, wherein the first solvent is a non-aqueous
3 solvent or solution.

1 54. The process for forming a patterned thin film structure on a
2 substrate as recited in claim 50, wherein the first solvent is an aqueous basic
3 solution, and the step of stripping the second material comprises using a second
4 solvent comprising an aqueous acidic solution, an aqueous neutral solution, or
5 water.

1 55. The process for forming a patterned thin film structure on a
2 substrate as recited in claim 50, wherein the first solvent is an aqueous acidic
3 solution and the step of stripping the second material comprises using a second
4 solvent comprising an aqueous basic solution, an aqueous neutral solution, or
5 water.

1 56. The process for forming a patterned thin film structure on a
2 substrate as recited in claim 50, wherein the first solvent is an aqueous neutral
3 solution or water and the step of stripping the second material comprises using
4 a second solvent comprising an aqueous acidic solution or an aqueous basic
5 solution.

1 57. A process for forming a patterned thin film structure on a
2 substrate, comprising:
3 printing a first pattern on a first surface of the substrate using a strippable
4 material comprising 5-80% by weight of a re-dispersible particulate, the
5 first pattern of strippable material defining an area on the first surface of
6 the substrate where a first thin film structure is to be formed;
7 depositing a thin film of thin film material on the patterned first surface of
8 the substrate;
9 stripping the first pattern of strippable material from the substrate;
10 printing a second pattern on a second surface of the substrate using a
11 strippable material comprising 5-80% by weight of a re-dispersible
12 particulate, the second pattern of strippable material defining an area on
13 the second surface of the substrate where a second thin film structure is
14 to be formed;
15 depositing a thin film of thin film material on the patterned second surface
16 of the substrate; and
17 stripping the second pattern of strippable material from the substrate;
18 whereby the first pattern of strippable material, the second pattern of
19 strippable material, and any thin film material formed on either the first or
20 the second pattern of strippable material are removed leaving behind the
21 first thin film structure on the first surface of the substrate and the second
22 thin film structure on the second surface of the substrate.

1 58. A process for forming a patterned thin film structure on a
2 substrate, comprising:
3 printing a first pattern on a first surface of the substrate using a strippable
4 material comprising 5-80% by weight of a re-dispersible particulate, the
5 first pattern of strippable material defining an area on the first surface of
6 the substrate where a first thin film structure is to be formed;
7 printing a second pattern on a second surface of the substrate using a
8 strippable material comprising 5-80% by weight of a re-dispersible
9 particulate, the second pattern of strippable material defining an area on

10 the second surface of the substrate where a second thin film structure is
11 to be formed;
12 depositing a thin film of material on the patterned first surface and on the
13 patterned second surface of the substrate; and
14 stripping the first pattern and second pattern of strippable material from
15 the substrate;
16 whereby the first pattern of strippable material, the second pattern of
17 strippable material, and any thin film material formed on either the first or
18 the second pattern of strippable material are removed leaving behind the
19 first thin film structure on the first surface of the substrate and the second
20 thin film structure on the second surface of the substrate.

1 59. The process for forming a patterned thin film structure on a
2 substrate as recited in claim 58, wherein the strippable material comprises 10-
3 60% by weight of the redispersible particulate.

1 60. The process for forming a patterned thin film structure on a
2 substrate as recited in claim 1, wherein the step of stripping comprises using
3 solvent to remove the strippable material.

1 61. The process for forming a patterned thin film structure on a
2 substrate as recited in claim 1, wherein the step of stripping comprises using
3 mechanical pressure to remove the strippable material.

1 62. The process for forming a patterned thin film structure on a
2 substrate as recited in claim 61, wherein using mechanical pressure comprises
3 brushing.

1 63. The process for forming a patterned thin film structure on a
2 substrate as recited in claim 61, wherein using mechanical pressure comprises
3 using a spray nozzle.

1 64. The process for forming a patterned thin film structure on a
2 substrate as recited in claim 1, wherein the step of stripping comprises:

3 applying an adhesive layer having a higher adhesive strength with
4 respect to the thin film and/or strippable material than the adhesive
5 strength of the strippable material to the substrate; and
6 removing the strippable material and any thin film formed thereon by
7 peeling off the adhesive layer.

1 65. The process for forming a patterned thin film structure on a
2 substrate as recited in claim 1, wherein the step of stripping comprises:
3 applying an adhesive layer to the substrate after the thin film deposition
4 step; and removing the thin film on the area with the first printed material
5 by peeling off the adhesive layer.

1 66. The method of claim 65, wherein the cohesion strength of the thin
2 film and the adhesion strength between thin film and the substrate are stronger
3 than any of the three forces: the cohesion strength of the strippable material, the
4 adhesion strength between the thin film and the strippable material, and the
5 adhesion strength between the strippable material and the substrate.